

## Risky behavior and exposure to noise among adolescents

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### Abstract

**Aim:** Adolescents are under greater risk of noise influence which affects their psychophysical health. The most common noise sources are too loud cinema halls, concerts, sports events, different outdoor events, street noise, and listening to music that is too loud on iPod and MP3 gadgets. The aim of this study was to investigate risk behaviors and attitudes among adolescents toward noise exposure; to explore how adolescents recognize symptoms and signs of noise influence to their own psychophysical health.

**Methods:** The study included 533 high school students aged 15-19 years. The data were collected using a questionnaire that contained a total of 32 questions/ attitudes/ statements. SPSS statistical software was used for data processing.

**Results:** Students in higher grades (third and fourth) show a better understanding of noise types that can damage hearing and they agree with the statement that listening to loud music can damage hearing, whereas students of first and second grades disagree. Younger students usually associate hearing loss with aging.

**Conclusion:** The study showed that such risky behavior of adolescents is in accordance with global trends. It can be and it has to be influenced by integrated programs within primary and secondary education. By continuous education of both children and parents when it comes to noise level in their living, working or entertainment environment, and when it comes to the ways in which they can decrease the noise level, damage to hearing can be prevented, or at least postponed.

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### Introduction

Noise is an unwanted, i.e. unpleasant or unexpected sound; a mixture of sounds having various properties which can be permanent,

abrupt and striking. The properties can vary in level, duration and distribution and can have multiple adverse effects on human health and hearing. Noise is an audible acoustic energy which can negatively affect the physiological

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and psychological state of humans. People are exposed to noise on a daily basis, including environmental, community, public and domestic noise, all of which represent one of the main issues of human environment, especially in city areas (1). Main noise sources in outdoor spaces are traffic, industry, construction and public activities, sports and leisure. Noise usually found in indoor spaces includes servicing equipment, music equipment and home appliances. Traffic is one of the main causes of noise. In cities, noise emitted by cars accounts for 80 % of noise in city areas. What is more, next to busy road junctions, the noise can reach up to 90 dB (2). About 80 million of Europeans live in areas where the level of noise exceeds recommended exposure limits. By reducing partial or total noise primarily in the public and work environment as well as the time of exposure, at least half of hearing damage cases could be prevented. Despite the fact that noise is an integral part of nature, factors such as industrial development, population growth and density and increased number of roads and vehicles, especially in urban settings, have led to an increase of noise exposure representing a threat to human health (Table 1). The impact of noise on human health can be direct, resulting in damage to the organ of hearing and balance. Also, it can be indirect and can affect the nervous, vascular, digestive and endocrine system. Direct noise results in partial and complete hearing loss, tinnitus, various speech disorders, problems related to communication and balance disorders such as unsteadiness while walking. Nowadays, noise is the main cause of hearing impairment. Prolonged exposure to noise, such as during the whole day, permanently damages our hearing. Noise induced by traffic, noise we are exposed to in school and at the work place, loud music, and most of all, neglecting to pay attention to our hearing, leads to noise-induced hearing loss (NIHL). Indirect effects on health include neurovegetative reactions such as hypertension, endocrine disorders and other metabolic disorders, as well as exhaustion, mental reactions (irritability) and low performance. Depending on their interests, upbringing, education and habits, adolescents are at higher risk of noise influencing their health and physical

and mental development. Sources of noise are mostly extremely loud sound levels in cinemas, concerts, sports events, restaurants, open air events, shopping malls, street noise and loud listening to music on headphones. Music played on iPods, CDs and MP3 players is one of the least known, but one of the most dangerous killers of hair cells. The volume of sound emitted by these devices sends music via headphones/earphones directly to our ear so that we no longer hear people around us or the noise of cars and trams, which means that the sound is too loud and potentially life-threatening. More than 78% to 90% of young people and approximately 50% of adults listen to music through headphones/earphones. About 50% of young people use personal music players from 1 to 3 hours per day and a significant number of young people even longer than that (3). It has been proven that exposure to noise of up to 85 dB during an 8-hour period causes hearing loss, while the level of sound volume emitted by iPods and MP3 players is much louder (usually more than 100 dB). Adolescents and young adults consciously expose themselves to very loud music, very often for several hours in succession. Loud music at concerts and in clubs, emitted by audio devices, represents a potentially dangerous source of noise. The noise level recorded at rock concerts ranges from 120 to 140 dB, while in restaurants, at weekends, the noise level exceeds 95 dB. According to a group of authors, professional exposure in nightclubs considerably exceeds the recommended noise level. Taking the weekly exposure to noise in nightclubs into account, a 5-hour stay in a typical club will expose the ear to noise equivalent to 98 dB (4). Extremely high and very dangerous noise levels can be found next to loudspeakers at big music events (e.g. open-air concerts). On the back of every event ticket, there is a sentence written in very small letters which warns the visitors that loud music can damage the hearing. Hence, the use of hearing protection, such as earplugs, which decrease the noise level but do not affect the quality of sound, is recommended to concert visitors. Two decades ago, a group of authors came to the conclusion that a temporary threshold shift of more than 10 dB can be observed after 3 hours of listening to music on

**Table 1.** Environmental sounds and the corresponding sound level (noise) in decibels

Environmental sounds	Sound exposure level (dB)
Threshold of hearing	0 – 25
Whisper	20
Conversational speech	40
TV	55
Apartment on a busy street, noise in a large business office	60
Busy traffic, noise in a cafe,	70
Car, hair dryer	70
Metro, big crowd	80
Truck, busy crossroads	90
Train passing	95
Chainsaw, drilling machine	100
Air hammer	105
Loud music	110
Rock concert near the speaker, thunder	120
A singer whose volume has reached the maximum	130
Threshold of pain	130 –140
Takeoff and landing of a plane	140
Space shuttle platform	180

medium noise levels via portable audio devices (5).

The aim of this study was to explore risk behavior of adolescents with respect to noise and their understanding of consequences of auditory overload on their psychophysical health.

## Material and Methods

The study included 533 students, aged between 15 and 19, attending "Pakrac" high school during November and December in 2016. The data was collected using a survey questionnaire especially designed for the purposes of this research. The questionnaire was divided into four parts. The first part included general data, like gender, date of birth, field of study the students are enrolled in. Employing a Likert-type scale, other parts of the questionnaire referred to statements on attitude, risky behavior and symptoms. The questionnaire contained a total

of 32 questions/attitudes/statements. The research was approved by the school ethics committee. Furthermore, the study was performed in accord with the ethical principles of the Declaration of Helsinki. In a meeting of all form teachers of "Pakrac" high school, the aim of the questionnaire and the instructions on how to fill it in, were briefly presented. The questionnaires were filled in during homeroom class. The whole process of conducting the survey questionnaire went on smoothly, with occasional questions regarding the meaning of particular questions/attitudes stated in the questionnaire.

## Statistical analysis

The Kolmogorov-Smirnov test was performed to test the data against normal distribution. The mean values of the continuous data are expressed by the median and interquartile range, while nominal indicators are shown by absolute and relative numbers. The differences between categorical variables were tested using the  $\chi^2$  test. In order to determine the difference between two independent samples, the Mann Whitney test was employed, while for three and more samples the Kruskal Wallis test was performed. Also, originally written database programs and the statistical software package SPSS (version 15.0) were used, using a significance level of  $\alpha = 0.05$ .

## Results

The study involved 533 participants (students) aged between 15 to 19. The sample included 200 (37.5%) male and 333 (62.5%) female students. While analyzing the research results, the participants were divided into two categories, i.e. junior and senior participants. The term "junior" refers to first- and second-year high-school students, while the term "senior" involves participants in the third, fourth and fifth grade. According to the obtained results, a statistically significant difference can be observed in the following attitudes: senior high-school students (third and fourth grade) show a statistically significant higher level of knowledge about

**Table 2.** Participants distribution according to risk behavior

Risk behavior	Number (%) of respondents					
	<i>I do not agree at all</i>	<i>I mostly disagree</i>	<i>I neither agree nor disagree</i>	<i>Mainly I agree</i>	<i>I agree</i>	<i>Total</i>
I listen to music every day for more than 1h through the headset	139 (26.1)	76 (14.3)	100 (18.8)	73 (13.7)	144 (27.1)	532 (100)
Family members complain that I listen to music or TV too loudly	209 (39.4)	108 (20.3)	59 (11.1)	72 (13.6)	83 (15.6)	531 (100)
Once a week (or more) I go to a nightclub or cafe bar	104 (19.6)	59 (11.1)	95 (17.9)	94 (17.7)	179 (33.7)	531 (100)
I adhere to warnings of my smartphone that the music is too loud	216 (40.7)	84 (15.8)	97 (18.3)	75 (14.1)	59 (11.1)	531 (100)
I often go to concerts and similar events	104 (19.6)	116 (21.8)	157 (29.6)	89 (16.8)	65 (12.2)	531 (100)
When I'm exposed to noise, I use protection in the form of earplugs or ear pads	416 (78.6)	61 (11.5)	24 (4.5)	16 (3)	12 (2.3)	529 (100)
I often participate in activities where I am exposed to noise	81 (15.2)	116 (21.8)	183 (34.4)	102 (19.2)	50 (9.4)	532 (100)
I live near some sources of noise	301 (56.6)	96 (18)	69 (13)	40 (7.5)	26 (4.9)	532 (100)

different types of noise that can damage the hearing ( $p < 0.05$ ). Also, they agree on the statement that loud music damages hearing ( $p < 0.05$ ) unlike the first-year and second-year students. Furthermore, senior participants believe that noise causes the highest damage during leisure time ( $p < 0.001$ ), which can result in anxiety, depression and high blood pressure ( $p < 0.05$ ). In contrast to their senior counterparts, junior students often connect hearing loss with older people. The distribution of participants with respect to risky behavior is shown in Table 2. A statistically significant difference regarding risky behavior can also be observed in the senior population of high-school students, who stated to rarely listen to music using headphones/earphones for more than an hour a day ( $p < 0.05$ ). All other statements relative to risky behavior do not point to a statistical significance between the different age groups. The highest overlap can be observed in the statement that noise has a negative effect on the students' ability to learn, while the statements that the participants experienced ear pain as a

result of listening to music using headphones/earphones and that the noise emitted by church bells and electronic devices in their living area (e.g. television, radio, air conditioner, refrigerator, washing machine, computer) made them feel uncomfortable, displayed the lowest level of agreement.

## Discussion

A lot of research has been carried out so far on the influence of noise on human health, especially that of young people, due to increasing exposure to levels that can directly and indirectly affect the health and quality of life. However, studies show that exposure to daily noise levels still represents a great public health and social issue, which has resulted in increased preventative measures. Preventative measures first included the adult population exposed to professional noise, while, at the same time, the number of children and adults with hearing loss is constantly on the increase. The results of this research point to the necessity to educate

adolescents with the aim to reduce their risky behavior and to influence their attitude towards noise. Out of the total number of respondents, 80% disagree with the statement that listening to loud music through headphones/earphones is connected with hearing impairment, which represents a worrying fact about the perception of noise among young people. A study was carried out among 1547 students of 13-19 years of age in Swedish schools. A significant difference was identified between socioeconomic and age groups. In other words, the age group of 13-15 displayed a better attitude towards noise, if compared to the age group ranging from 16 to 19. Older adolescents stated to better take care of their hearing than younger adolescents (6). The results of the study in question are compatible with the results of this research, where older participants (3rd, 4th and 5th graders) are better acquainted with different noise types, risky behavior (listening to loud music) and the possible adverse effects. On the other hand, risky behavior of younger participants (1st and 2nd grade) is displayed in the amount of time spent listening to music using headphones/earphones, which is more than one hour. The same group of respondents (78.6%) do not use any kind of ear protection, be it earmuffs or earplugs. The cause of such an attitude could be found in the fact that younger participants connect hearing loss with older people. A six-year study carried out in the USA showed that 12% of children aged 6 to 19 suffer from noise-induced hearing-threshold shifts (7). Research of some authors shows that 1% of all school children suffer from some kind of hearing damage (8). Several years of exposure to loud music suffices to cause damage to the inner ear. It is estimated that after 10 years of exposure to loud music via audio devices in clubs and concerts, approximately 10% of people will suffer from irreversible bilateral hearing loss at a frequency of 3 kHz (9). During 2005, a group of researchers performed a study on hearing loss among young people caused by noise. Due to the fact that a large number of young people expose themselves to loud music in their free time, the researchers assumed that young people are unaware that exposure to loud music can result in hearing loss. In their research, they

used a questionnaire which consisted of 28 questions. They presented the questionnaire on the public web site of a television network with the aim to find out the attitude of young people towards general health issues, including hearing loss. Only 8% of respondents recognized the problem of hearing loss as a great health issue. The majority of participants experienced tinnitus or temporary, reversible hearing loss after visiting concerts (61%) and clubs (43 %). Only 14% stated to have used earplugs. Still, it is encouraging that the majority of the respondents would have been willing to use ear protection if educated or warned by a doctor about possible permanent hearing impairment (10). Despite the evidence on the adverse effects of noise on young people, neither guidelines nor safety standards have been defined yet. Scientists warn that today's generations of young people are at higher risk of facing hearing damage at an earlier age than older generations. If music is listened to too often, doctors recommend keeping the volume at 60% of the maximum. As many as 22.4% of our participants sometimes experience buzzing in the ears; however, we do not possess any information as to whether this percentage increases with age. Today's studies indicate that the number of tinnitus cases will rise with age in children due to long-term exposure to noise. 45.1% of our participants indicated to have concentration problems due to environmental noise, while 57.3% answered to have problems with learning when noise is present. Furthermore, 66% of the students study the easiest and most effectively when in silent environments. The results confirm that the presence of noise makes young people feel uncomfortable and that it causes lack of concentration. Hearing loss can be prevented if children and parents are adequately educated about noise levels in the environment they live, work or entertain themselves in and about the methods they can use to reduce noise.

## Conclusion

The research has shown that risky behavior in adolescents follows global trends. The trends can be altered by using integrated programs during primary and secondary school education.



Also, it is very important to educate the educators, who will then better convey their knowledge in a way that is more appealing to young people. Young people are more prone to change their habits, hence quality education can lead to easier changes in young people's attitude towards noise. Raising public awareness and promoting activities regarding the prevention of hearing loss will improve the health of the ear and hearing. Some of the preventative activities include restriction on exposure to loud noise, reduction of noise levels whenever possible or avoidance of noise sources. It is of utmost importance to perform further research on risky behavior and exposure to noise in youth in order to publish quality literature adapted to the current situation. This way, we can achieve better results and education aimed at the core of the problem.

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